PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : D21H 27/02, B31F 1/07 — A1

(11) International Publication Number: WO 96/31652

(43) International Publication Date: 10 October 1996 (10.10.96)

(21) International Application Number: PCT/US96/04777

(22) International Filing Date: 4 April 1996 (04.04.96)

(30) Priority Data:
08/416,348 4 April 1995 (04.04.95) US

(71) Applicant: JAMES RIVER CORPORATION OF VIRGINIA [US/US]; P.O. Box 2218, Richmond, VA 23217 (US).

(72) Inventor: SCHULZ, Galyn, A.; N. 1536 Skyline Drive, Greenville, WI 54942 (US).

(74) Agents: GARRETT, Arthur, S. et al.; Finnegan, Henderson, Farabow, Garrett & Dunner, L.L.P., 1300 I Street, N.W., Washington, DC 20005-3315 (US).

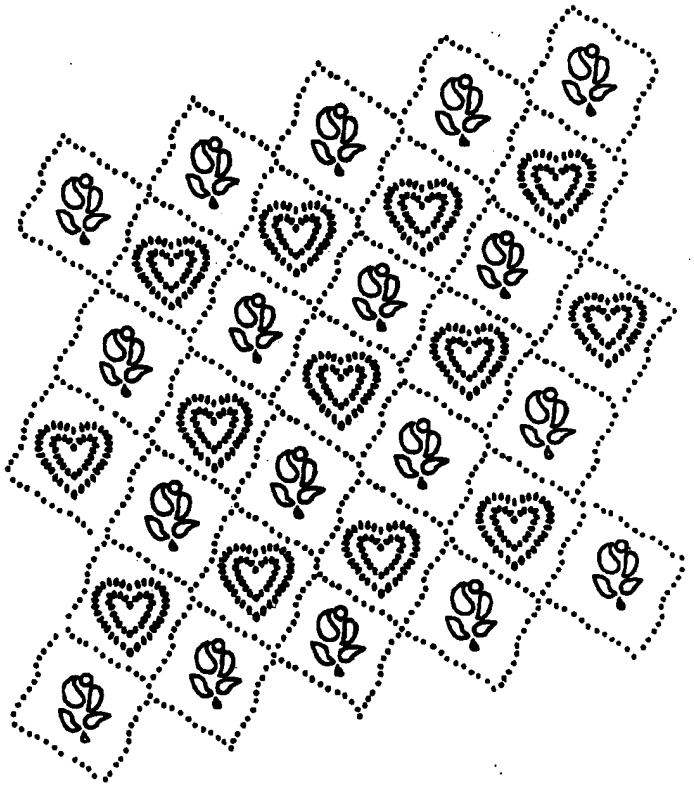
(81) Designated States: CA, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: HIGH BULK EMBOSSED TISSUE WITH NESTING PREVENTION

(57) Abstract

An embossed tissue having improved bulk and puffiness while being non-nesting by having a lattice pattern and at least two signature bosses. More particularly, one of the signature bosses is defined by embossments having a lower portion which is continuous and an upper portion which is defined by crenels and merlons.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	GB	United Kingdom	MW	Malawi
AT	Austria	GE	Georgia	MX	Mexico
AU	Australia	GN	Guinea	NE	Niger
BB	Barbados	GR	Greece	NL	Netherlands
BE	Belgium	HU	Hungary	NO	Norway
BF	Burkina Faso	IE	Ireland	NZ	New Zealand
BG	Bulgaria	IT	Italy	PL	Poland
BJ	Benin	JP	Japan	PT	Portugal
BR	Brazil	KE	Kenya	RO	Romania
BY	Belarus	KG	Kyrgyzstan	RU	Russian Federation
CA	Canada	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic			SE	Sweden
CG	Congo	KR	Republic of Korea	SG	Singapore
CH	Switzerland	KZ	Kazakhstan	SI	Slovenia
CI	Côte d'Ivoire	LI	Liechtenstein	SK	Slovakia
CM	Cameroon	LK	Sri Lanka	SN	Senegal
CN	China	LR	Liberia	SZ	Swaziland
CS	Czechoslovakia	LT	Lithuania	TD	Chad
CZ	Czech Republic	LU	Luxembourg	TG	Togo
DE	Germany	LV	Latvia	TJ	Tajikistan
DK	Denmark	MC	Monaco	TT	Trinidad and Tobago
EE	Estonia	MD	Republic of Moldova	UA	Ukraine
ES	Spain	MG	Madagascar	UG	Uganda
FI	Finland	ML	Mali	US	United States of America
FR	France	MN	Mongolia	UZ	Uzbekistan
GA	Gabon	MR	Mauritania	VN	Viet Nam

HIGH BULK EMBOSSED TISSUE WITH NESTING PREVENTION

RELATED APPLICATIONS

This application is a continuation-in-part of U.S. Patent Application Serial No. 08/169,628, filed December 20, 1993, now pending. This application is also a continuation-in-part of U.S. Patent Application Serial No. 07/999,414, filed December 24, 1992, now pending. Both of these applications are incorporated by reference herein, in their entirety.

Field of the Invention

The present invention relates to an embossed web or sheet exhibiting high bulk and good emboss pattern definition. The invention further relates to a uniform roll of embossed tissue. In still another aspect, the present invention relates to an embossed element having a cross section including crenels and merlons.

Background of the Invention

Tissue produced using conventional wet press technology must usually be embossed subsequent to creping to improve bulk, appearance and softness. It is known in the art to emboss sheets comprising multiple plies of creped tissue to increase the surface area of the sheets thereby enhancing their bulk and moisture holding capacity. Toilet tissue is usually marketed in rolls, containing a specified number of sheets per roll. Tissue embossed in conventional patterns of spot debossments, when packaged in roll form, exhibit a tendency to be non-uniform in appearance often due to uneven buildup of the bosses as the sheet is wound onto the roll. This results in a ridging effect detracting from the appearance of the rolls.

Embossing patterns and methods that emboss products in manner selected to avoid nesting of the bosses in rolled,

folded or stacked sheets of paper product are known. For one example of such a pattern and method, see U.S. Patent No. 4,659,608. This prior art pattern, while improving the nesting problem associated with previous prior art patterns, to only four location, was faced with a spiralling effect similar to the visual spinning of a barber shop pole. In addition, this prior art pattern wrinkles and ridges due to stresses placed upon the boss pattern.

The present invention minimizes this buildup and ridging problem while improving the bulk of the tissue product. The pattern which is formed in the tissue of the present invention may be formed either by debossing or embossing. When an emboss pattern is formed, the reverse side of the sheet retains a deboss pattern. The projections which are formed are referred to as bosses. When a deboss pattern is formed, the reverse side of the sheet retains an emboss pattern and the projections are still referred to as bosses. Thus, the methodologies may be interchanged while producing the same product.

SUMMARY OF THE INVENTION

The present invention provides an embossed paper product which is significantly higher in bulk than prior art products. When formed into a roll, the embossed paper products of the present invention has superior roll compression and improved roll structure. Furthermore, the embossing process as described in the present invention requires less penetration depth than prior art emboss techniques resulting in improved life for the embossing rolls and machinery used. In addition, the embossed product of the present invention does not suffer from the disadvantages of the prior art products due to substantial nesting of the boss patterns resulting in uneven and poor roll quality.

To achieve the foregoing advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, there is disclosed:

A sheet of tissue exhibiting puffiness and bulk having a plurality of bosses formed therein comprising;

a plurality of stitchlike bosses arrayed to form polygonal cells making up a lattice structure; and

a plurality of bosses forming a first signature boss pattern being centrally arrayed within a plurality of cells, said first signature bosses being formed of linear continuous embossments at a height exceeding 3 thousandths of an inch and a height less than 120 thousandths of an inch;

a plurality of bosses forming a second signature boss pattern being centrally arrayed within a plurality of cells, said second signature boss pattern being formed of linear crenulated embossments at a height exceeding 3 thousandths of an inch and a height less than 120 thousandths of an inch and defining a plurality of merlons and crenels, wherein said crenels extend to a depth of at least 2 thousandths of an inch.

There is further disclosed:

A roll of tissue exhibiting puffiness and bulk having a plurality of bosses formed therein comprising:

an array of stitchlike bosses forming a lattice of polygonal cells;

each said polygonal cell being centrally filled with a plurality of bosses forming one of a multiplicity of signature boss patterns comprising at least a first signature boss pattern and a second signature boss pattern, said first signature boss pattern being non-nesting with said second signature emboss pattern,

said bosses being arrayed such that one of said first signature bosses nests with another of said first signature bosses at no more than three locations within said roll and one of said second signature boss nests with

another of said second signature bosses at no more than three locations within said roll.

There is still further disclosed:

A nonwoven fibrous web having an emboss element thereon comprising:

a nonwoven fibrous web the majority thereof defining a base plane;

a crenulated emboss element formed therein and extending upwardly from said base plane, said crenulated emboss element having an upper and a lower portion;

said lower portion being continuous between said base plane and a first plane, said first plane defining the upper edge of said lower portion and the lower edge of said upper portion; and

said upper portion having crenels and merlons extending between a second plane defining the uppermost edge of said element and said first plane, said crenels and merlons being spaced along the upper edge of said lower portion of said crenulated emboss element.

There is finally disclosed:

A sheet of tissue exhibiting puffiness and bulk having a plurality of bosses formed therein comprising;

a plurality of stitchlike bosses arrayed to form polygonal cells making up a lattice structure; and

a plurality of bosses forming a first signature boss pattern being centrally disposed within a plurality of cells, said plurality of bosses having a height exceeding 3 thousandths of an inch and a height less than 120 thousandths of an inch;

a plurality of bosses forming a second signature boss pattern being centrally disposed within a plurality of cells, said second signature boss pattern being formed of at least two concentrically arranged arrays of embossments at a height exceeding 3 thousandths of an inch and a height less than 120 thousandths of an inch.

Additional advantages of the invention will be set

forth in part in the description which follows, and in part will be apparent from the description, or may be learned by practice of the invention. The objects and advantages of the invention will be realized and attained by means of the elements and combination particularly pointed out in the appended claims.

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate various aspects of the invention and, together with the description, serve to explain the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a top plan view of one emboss pattern of the present invention.

Figure 2 is a cross-sectional view of the pattern of Figure 1.

Figure 3 is a top plan view of one signature boss of the emboss pattern of Figure 1.

Figure 4 is a cross-sectional view of a signature boss of Figure 3.

Figure 5 is a cross-sectional view of a stitchlike boss.

Figure 6 is a depiction of the boss elements of the signature boss of Figure 3.

Figure 7 is a top plan view of another signature boss of the emboss pattern of Figure 1.

Figure 8 is a cross-sectional view of the signature boss of Figure 7.

Figure 9 is a cross-sectional view of an emboss element used in Phase I of the development of the double heart design.

Figure 10 is a cross-sectional view of an emboss element used in Phase II of the development of the double heart design.

Figure 11 is a cross-sectional view of an emboss element used in Phase III of the development of he double heart design.

Figure 12 is a cross-sectional view of a crenulated emboss element.

Figures 13 is a photograph of the pattern of Figure 1.

Figure 14 is an enlarged photograph of a portion of the pattern of Figure 1.

Figure 15 is the Tulips Everywhere pattern used in the trials of Example 1.

Figure 16 is the Tulips and Roses pattern used in the trials of Example 1.

Figure 17 is the Single Heart pattern used in the trials of Example 1.

Figure 18 is the Tulips and Stitches pattern used in the trials of Example 1.

Figure 19 is the current Northern Bathroom Tissue pattern used in the trials of Example 1.

Figure 20 is a general comparison of GM MMD Friction versus GM Modulus.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is a paper product having improved bulk and superior pattern definition characteristics while minimizing substantial nesting of the emboss patterns resulting in a product having superior roll quality.

The paper product of the present invention is made up of a nonwoven fibrous web, more preferably a tissue, having an emboss pattern formed thereon.

In one embodiment of the present invention, the product may include a first set of bosses which resemble stitches, hereinafter referred to as stitchlike bosses which resemble dot, dashes or the like, and at least one second set of bosses which are referred to as signature bosses. Signature bosses may be made up of any emboss design and are often a

design which is related by consumer perception to the particular manufacturer of the tissue.

The diameter of the stitchlike boss is preferably at least one and one half times the line width of the continuous or crenulated signature bosses. More preferably, the diameter is two or three times the line width.

In another aspect of the present invention, a paper product is embossed with a wavy lattice structure which forms polygonal cells. These polygonal cells may be diamonds, hexagons, octagons, or other readily recognizable shapes. In one preferred embodiment of the present invention, each cell is filled with a signature boss pattern. More preferably, the cells are alternatively filled with at least two different signature emboss patterns.

In another preferred embodiment, one of the signature emboss patterns is made up of concentrically arranged elements. These elements can include like elements for example, a large circle around a smaller circle or differing elements, for example a larger circle around a smaller heart. In a most preferred embodiment of the present invention, at least one of the signature emboss patterns are concentrically arranged hearts as can be seen in Figure 1. In the most preferred embodiment, the other signature emboss element is a flower.

The embossed paper product of the present invention improves over the prior art product in a number of characteristics. The use of concentrically arranged emboss elements in one of the signature emboss patterns adds to the puffiness effects realized in the appearance of the paper product tissue. The puffiness associated with this arrangement is the result not only of appearance but also of an actual raising of the tissue upward between the two concentric elements.

In one embodiment of the present invention, emboss elements are formed having the uppermost portions thereof

formed into crenels and merlons, herein after referred to as "crenulated emboss elements". By analogy, the side of such an emboss element would resemble the top of a castle wall having spaced projections which are merlons and depressions therebetween which are crenels. Crenulated emboss elements have the advantages of adding high bulk to the paper substrate and further providing enhanced definition and pattern retention to the embossed pattern.

Any of the emboss elements either stitch-like or signature may be formed of crenulated emboss elements. In a preferred embodiment, at least one of the signature emboss patterns is formed of crenulated emboss elements. More preferably, the signature boss pattern is two concentrically arranged hearts, one or both of which is crenulated.

The crenels may be placed in a patterned arrangement of they may be randomly spaced both in the longitudinal and cross-sectional directions. In one preferred embodiment, the crenels are uniformly spaced in both the cross-sectional and longitudinal directions. In another preferred embodiment, the crenels are longitudinally spaced along the periphery of the emboss element. In still another preferred embodiment, the crenels are arranged in a pattern of clusters which vary in number. Finally, in another preferred embodiment, the crenels are arranged randomly on the emboss element. It is understood that the skilled artisan can arrange the crenels in any manner which achieves the objectives of bulk, absorbency and feel desired for the particular application.

The crenels preferably have a width between 2 and 40 thousandths of an inch, more preferably between 5 and 25 thousandths of an inch. The merlons preferably have a width of from 2 to 40 thousandths of an inch, more preferably from 5 to 25 thousandths of an inch.

In a preferred embodiment of the present invention, the signature bosses have a height of between 3 thousandths and 120 thousandths of an inch, more preferably between 5 and

100 thousandths of an inch, still more preferably 40 to 80 thousandths and most preferably 50 to 70 thousandths of an inch. The crenels are preferably at a depth of at least 2 thousandths of an inch, more preferably at least 3 thousandths of an inch. In one embodiment of the present invention, the crenels can be of a depth which approaches the depth of the emboss element, i.e., the crenel extends substantially to the base plane or web. The crenels are preferably at a depth of less than 30 thousandths of an inch and most preferably at less than 15 thousandths of an inch. It is understood that the use of merlons which are unequally spaced or which differ in height are embraced within the present invention.

According to the one embodiment of the present invention, when the web or sheets are formed into a roll, the tissue is aligned so that the bosses are internal to the roll and the debossed side of the tissue is exposed. In the present invention, the boss pattern is offset from the machine direction in the cross direction, the machine direction being parallel to the free edge of the web, by more than 0° to less than 180°, preferably more than 10° to less than 170°.

In one embodiment of the present invention, the boss pattern combines stitchlike bosses with a first signature boss made up of linear continuous embossments and a second signature boss pattern made up of crenulated embossments. The overall arrangement of the pattern is selected so that when the sheets are formed into a roll, the signature bosses fully overlap at a maximum of three location in the roll, more preferably at two locations, the outermost of these being at least a predetermined distance, e.g., about an eighth of an inch, inward from the exterior surface of the roll. Moreover, the overall average boss density is substantially uniform in the machine direction of each strip in the roll. The combined effect of this arrangement is

that the rolls possess very good roll structure and very high bulk.

The signature bosses are substantially centrally disposed in the cells formed by the intersecting flowing lines and serve to greatly enhance the bulk of the tissue while also enhancing the distortion of the surface thereof. At least some of the signature bosses are continuous rather than stitchlike and can preferably be elongate. Other of the signature bosses are crenulated and are also substantially centrally disposed in cells formed by the intersecting flowing lines. The signature bosses enhance the puffy or filled appearance of the sheet both by creating the illusion of shading as well as by creating actual shading due to displacement of the sheet apparently caused by puckering of the surrounding regions due to the embossing or debossing of the signature bosses.

During production trials, a single heart design was produced using a single continuous embossment. The continuous embossment heart was replaced with a single crenulated heart, which provided significant improvements in bulk. Finally, the single heart was replaced with a double heart design comprised of one heart concentrically disposed within a second larger heart. This double heart pattern used crenulated emboss elements for both hearts. The double heart pattern achieved a further improvement in bulk and as described above was perceived as puffier by the displacement of the web upward between the two concentric elements.

Figure 1 illustrates a preferred emboss pattern according to the present invention. The pattern includes first signature bosses (tulips) and second signature bosses (double hearts) which are included within a criss-cross pattern of wavy lines which define polygonal cells having a diamond shape. As can be seen from Figure 1, the wavy lines are formed from stitchlike or dot-like bosses. As is also clear from Figure 1, when the emboss pattern is applied to a paper product, the pattern is offset at an angle from the

machine direction. This offset prevent substantial nesting of similar signature bosses.

Figure 2 is a cross-sectional view of the pattern as illustrated in Figure 1. The cross section includes one embossment of the flower (two sides), one stitchlike boss of the lattice-like pattern and both the interior and exterior heart patterns. Accordingly, viewing the cross section from left to right, the first two elements are part of the continuous element which makes up one part of the tulip pattern. The next, rounder element is a stitchlike element which makes up the wavy lattice pattern. Finally, the last two elements are the exterior and interior hearts, respectively. The values given are emboss depths in thousandths of an inch for one preferred embodiment according to the present invention.

Figure 3 illustrates a single diamond element of the lattice structure of the pattern illustrated in Figure 1, containing a double heart. Views 4-4 and 5-5 are set forth in Figures 4 and 5, respectively. In Figure 3, the rectangular coordinates for points 1-6 which define the double heart pattern in a preferred embodiment of the present invention are set forth in Table 1, below:

Table 1

PT #	Rectangular Coordinates
1	-.1953,.3532
2	-.1972,.5447
3	-.1972,.8580
4	-.1972,1.0463
5	-0.538,.9252
6	-.9295,1.2993

Figure 4 illustrates a cross-sectional view of the embossments of both hearts in the double heart design. The dotted lines represent partial depth between heart elements. The values given refer to emboss depths for the elements in one preferred embodiment of the present invention. The tightest bottom gap was measured at 0.013".

Figure 5 illustrates a cross-sectional view of a stitchlike embossment which forms the polygonal cell pattern. The diameter of the embossment has been measured from the apex in 0.005 inch increments to the depth of the boss of 0.050 inches. The diameters of the stitchlike embossment are set forth below in Table 2:

Table 2

Depth	Sectioned Dot Diameter
.005	.051
.010	.063
.015	.068
.020	.073
.025	.078
.030	.082
.035	.087
.040	.092
.045	.096
.050	.101
.055	.106

Figure 6 illustrates the double heart emboss pattern of a preferred embodiment of the present invention. The distance between the bottoms of each element were measured at a depth of 15 thousandths of an inch. The distances are given in Table 3 below. The distances are set forth in inches.

Table 3

Point	Distance	Point	Distance
1	.0196	15	0.0203
2	.0196	16	.0196
3	.0192	17	.0224
4	.0192	18	.0129
5	.0188	19	.0160
6	.0183	20	.0135
7	.0217	21	.0145
8	.0222	22	.0193
9	.0228	23	.0223
10	.0229	24	.0226
11	.0226	25	.0216
12	.0226	26	.0204
13	.0220	27	.0189
14	.0214		

Figure 7 illustrates a single diamond element of the lattice structure of the pattern illustrated in Figure 1, containing a tulip. View 8-8 is set forth in Figures 8. All measurements set forth on Figure 7 are set forth in inches. In Figure 7, the rectangular coordinates for points 1-9 which define the tulip pattern in this preferred embodiment are set forth in Table 4, below:

Table 4

Point #	Rectangular Coordinates
1	-.1709,.4963
2	-.2463,.5976
3	-.2771,.6501
4	-.4982,.8486
5	-.2304,.7340
6	.0467,.7845
7	-.1884,.8766
8	-.3286,1.1910
9	-.2135,1.1849

The dots 1-46 in this Figure correspond to the rectangular coordinates as set forth in Table 5, below:

Table 5

Dot	Rectangular Coordinates	Dot	Rectangular Coordinates	Dot	Rectangular Coordinates
1	-.0123,.0459	17	-.7093,1.0614	33	.3063,1.2043
2	-.0871,.1125	18	-.6799,1.1581	34	.3745,1.1519
3	-.1553,.1650	19	-.6834,1.2521	35	.4493,1.0852
4	-.2444,.2157	20	-.6633,1.3417	36	.4740,.9935
5	-.3339,.2503	21	-.6032,4.4177	37	.4358,.8979
6	-.4205,.3032	22	-.5430,1.4961	38	.3803,.8149
7	-.4954,.3697	23	-.4875,1.5790	39	.3201,.7365
8	-.5794,.4366	24	-.4493,1.6746	40	.2600,.6606
9	-.6732,.4828	25	.3762,1.6117	41	.2399,.5710
10	-.7604,.5172	26	-.2988,1.5565	42	.2434,.4769
11	-.8378,.5723	27	-.2116,1.5221	43	.2140,.3802
12	-.9109,.6353	28	-.1178,1.4760	44	.1610,.2949
13	-.9356,.7271	29	-.0338,1.4091	45	.0985,.2165
14	-.8802,.8148	30	.0411,1.3425	46	.0431,.1335
15	-.8248,.8978	31	.1278,1.2896		
16	-.7623,.9761	32	.2173,1.2550		

Figure 8 illustrates a cross-sectional view of one embossment of the tulip design. The values set forth in Figure 8 are in inches.

Figures 9-11 will be described fully in the Example 3, below.

Figure 12 is a cross sectional view of the crenulated portion of the double heart emboss pattern of Figure 3. The relative depths of the crenulations are set forth as 0.015" and the width of the top of the merlons in this preferred embodiment is either 0.030 or 0.035 inches.

Figure 13 is a photograph of a section of toilet tissue having the preferred pattern as set forth in Figure 1, embossed thereon.

Figure 14 is an enlarged photograph of a section of toilet tissue which shows the preferred pattern of Figure 1. This photograph clearly shows that the concentrically arranged emboss elements cause the tissue to project forward. This adds to the perception of puffiness, quilting and overall softness.

Figure 15 was a comparative pattern used in Example 1, below. In this pattern, tulips were placed into each cell of the lattice.

Figure 16 is a comparative pattern used in Example 1, below. In this pattern, tulips are alternated with roses in the cells of the lattice.

Figure 17 is a comparative pattern used in Example 1, below. In this pattern, tulips and single hearts are alternated within the cells of the lattice.

Figure 18 is a comparative pattern used in Example 1, below. In this pattern, cells containing tulips are alternated with cells containing a pattern of stitches.

Figure 19 is a comparative pattern used in Example 1, below. This pattern places tulips in the cells of the lattice but leaves each alternating cell empty. This is the current commercial pattern for Quilted Northern Bathroom Tissue.

Figure 20 is a graph that sets forth the general relationship between GM Friction and GM Modulus. As can be seen from the graph, a low friction and a low modulus are both preferred, however, a gain in one may be offset by a loss in the other.

The following examples are not to be construed as limiting the invention as described herein.

Examples

Example 1

In assessing the feasibility of a change in the pattern for Quilted Northern Bathroom tissue, six patterns were selected and visual testing was conducted.

The six patterns which were selected are exemplified in Figures 1, and 15-19. Figure 1 is the preferred pattern of the present invention. Figure 19 is the current commercial pattern for Northern Bathroom tissue.

After the patterns were selected, the patterns were laser engraved into hard plastic plates and transferred under pressure to sheets of tissue. The double heart pattern was crenulated, however, depth of emboss and caliper cannot be used for comparison purposes because they differ between laser engraved plastic plates as used in the trial and steel rolls which are used to produce commercial products. The interrelation of these two variables is demonstrated below for steel rolls (See example 3).

These sheets were then placed before consumers who were instructed not to touch them, and a series of questions ensued.

The results of these tests are set forth in Tables 6 and 7 below.

Table 6

Design Attribute Ratings

% Rated Best/Second Best
Total No. of Respondents = 300

	Current	Double Heart	Single Heart	Tulips Everywhere	Tulips & Roses	Tulips & Stitches
Key Attributes	%	%	%	%	%	%
Attractive	33	42	37	26	25	20
Puffy	26	44	33	25	27	25
Quilted	23	45	34	19	24	31
Thick	26	35	30	25	26	27
Second Attributes	%	%	%	%	%	%
Approp. for Quilt Northern	33	36	33	29	27	20
Soft	34	34	33	27	25	22
Comfort	34	37	31	28	24	25
Absorbent	29	38	33	27	23	23
Cushiony	27	40	30	21	24	27
Strong	26	42	29	24	24	28

Table 7

Design Attribute Ratings

% Rated Excellent/Very Good
Total No. of Respondents = 300

	Current	Double Heart	Single Heart	Tulips Everywhere	Tulips & Roses	Tulips & Stitches
Key Attributes	%	%	%	%	%	%
Attractive	50	57	57	58	55	40
Puffy	43	62	57	54	54	46
Quilted	44	63	61	53	59	51
Thick	42	54	50	46	48	46
Second Attributes	%	%	%	%	%	%
Approp. for Quilt Northern	54	55	53	55	55	42
Soft	51	55	53	51	52	42
Comfort	53	51	54	52	50	46
Absorbent	41	57	52	49	51	42
Cushiony	43	59	53	48	51	47
Strong	42	56	48	47	48	45

Based upon initial consumer perception, the double heart pattern was far superior to the other similar designs. Upon the success of the Double Heart/Flower pattern of Figure 1, this pattern was selected for pilot plant trials.

In use tests conducted in the homes of consumers, the two patterns did comparably based upon the questions asked. The Double Heart/Flower pattern, however, received significantly better results when comparing voluntary comments. Based upon these results, plant trials were carried out for the double heart design.

Example 2

Plant trials were carried out to produce the Double Heart/Flower design for Northern Bathroom tissue. The physical data for the rolls produced during this trial is set forth in Table 9, below.

Table 9

Tissue Product Characteristics

Product	Sheet Count	Emboss Process	Basis Weight (lbs/rm)	Caliper (mils)	MD Tensile (gm/3")	CD Tensile (gm/3")	GM Friction	GM Modulus	Roll Diameter (inches)	Roll Compression (%)	Penetration Depth (mls)
G10 CONTROL	280	current commercial pattern	18.8	71.9	1046	388	0.145	19.4	4.20	18.0	80
G 37	280	Double Heart/ Flower	18.7	72.6	1065	417	0.154	19.0	4.20	18.5	47
G 39	250	Double Heart/ Flower	18.7	75.5	1021	408	0.154	18.9	4.18	21.1	50
G 32	280	Double Heart/ Flower	18.8	71.4	1138	457	0.156	22.3	4.19	17.0	45
G 34	250	Double Heart/ Flower	18.8	74.9	1091	428	0.173	18.9	4.18	20.5	50
G 33	280	Double Heart/ Flower	18.8	76	1055	408	0.173	20.4	4.17	14.8	50
G 35	250	Double Heart/ Flower	18.4	82.6	999	393	0.169	17.7	4.17	16.8	55

In Table 9, G13 and G35 were phase I of the testing. Figure 9 is a photomicrograph of the shape of the emboss element of Phase I. G34 and G32 were phase II of the testing. Figure 10 is a photomicrograph of the shape of the emboss element of Phase II. G39 and G37 were phase III of the testing. Figure 11 is a photomicrograph of the shape of the emboss element of Phase III.

The basis weight in Table 9 is a relative measure of the amount of fiber used in the production of the roll. Caliper is an indicator of the thickness of the tissue. MD tensile and CD tensile are indicators of the strength or failure of the tissue. GM friction and GM modulus are best if they are low but a rise in one may be offset by a drop in the other. Roll compression is a relative indicator of how firm a roll is perceived to be. Finally, penetration depth is the depth to which the web is embossed without reference to the element size.

As seen from the data, the tissues according to the preferred embodiments of the present invention are far superior to the control. The results achieved at the lower emboss penetration depths using the crenulated embossing technique could not be achieved with the control emboss pattern.

Other embodiments of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. It is intended that the specification and examples be considered as exemplary only, with a true scope and spirit of the invention being indicated by the following claims.

I CLAIM:

1. A sheet of tissue exhibiting puffiness and bulk having a plurality of bosses formed therein comprising;

a plurality of stitchlike bosses arrayed to form polygonal cells making up a lattice structure; and

a plurality of bosses forming a first signature emboss pattern being centrally arrayed within a plurality of cells, said first signature bosses being formed of linear continuous embossments at a height exceeding 3 thousandths of an inch and a height less than 120 thousandths of an inch;

a plurality of bosses forming a second signature emboss pattern being centrally arrayed within a plurality of cells, said second signature bosses being formed of linear crenulated embossments at a height exceeding 3 thousandths of an inch and a height less than 120 thousandths of an inch and defining a plurality of merlons and crenels, wherein said crenels extend to a depth of at least 2 thousandths of an inch.

2. The sheet according claim 1, wherein the combination of lattice structure and signature bosses are offset from the machine direction.

3. The sheet according claim 2, wherein the combination is offset from about 15 to 65 degrees from the machine direction.

4. The sheet according to claim 1, wherein the continuous signature bosses have a height of about 40 to 80 thousands of an inch and the crenulated signature bosses have a height of about 40 to 80 thousands of an inch.

5. The sheet according to claim 1, wherein the stitchlike bosses have a height of about 40 to 80 thousands of an inch.

6. The sheet according to claim 1, wherein the diameter of the stitchlike boss is at least one and one half times the width of a line of the continuous or crenulated signature boss.

7. The sheet according to claim 1, wherein the diameter of the stitchlike boss is at least twice the width of a line of the continuous or crenulated signature boss.

8. The sheet according to claim 1, wherein the diameter of the stitchlike boss is at least three times the width of a line of the continuous or crenulated signature boss.

9. The sheet according to claim 1, wherein said polygonal cells are diamond shaped cells.

10. The sheet according to claim 1, wherein said sheet is approximately 3 polygonal cells wide.

11. The sheet according to claim 1, wherein the polygonal cells have generator lines which connect the apices of the polygonal cells, and wherein the center of the stitchlike boss farthest from the generator line is a distance equivalent to at least 1 diameter of said stitchlike boss but no more than 3 diameters of said stitchlike boss from said line.

12. The sheet according to claim 1, wherein the stitchlike bosses are substantially circular dots.

13. The sheet according to claim 1, wherein the stitchlike bosses resemble dashes.

14. The sheet according to claim 13, wherein the dashes have an aspect ratio of less than 5.

15. The sheet according to claim 1, wherein the polygonal cells are hexagonal cells.

16. The sheet according to claim 1, wherein the polygonal cells are octagonal cells.

17. The sheet according to claim 1, wherein the crenulated signature bosses are configured as two concentrically arranged hearts.

18. A roll of tissue exhibiting puffiness and bulk having a plurality of bosses formed therein comprising:

an array of stitchlike bosses forming a lattice of polygonal cells;

each said polygonal cell being centrally filled with a plurality of bosses forming one of a multiplicity of signature emboss patterns comprising at least a first signature emboss pattern and a second signature emboss pattern, said first signature emboss pattern being non-nesting with said second signature emboss pattern,

said bosses being arrayed such that one of said first signature emboss patterns nests with another of said first signature emboss patterns at no more than three locations within said roll and one of said second signature emboss patterns nests with another of said second signature emboss patterns at no more than three locations within said roll.

19. The roll according to claim 18, wherein said bosses are configured such that substantial nesting of said signature bosses on a roll occurs at a maximum of two locations.

20. The roll according to claim 18, wherein crenulated signature bosses are configured as two concentrically arranged hearts.

21. A nonwoven fibrous web having an emboss element thereon comprising:

a nonwoven fibrous web the majority thereof defining a base plane;

a crenulated emboss element formed therein and extending upwardly from said base plane, said crenulated emboss element having an upper and a lower portion;

said lower portion being continuous between said base plane and a first plane, said first plane defining the upper edge of said lower portion and the lower edge of said upper portion; and

said upper portion having at least two crenels and at least one merlon extending between a second plane defining the uppermost edge of said element and said first plane, said crenels and merlons being spaced on the upper edge of said lower portion of said crenulated emboss element.

22. The web according to claim 21, wherein the

distance between the first plane and the second plane is less than 30 thousandths of an inch.

23. The web according to claim 22, wherein the distance between the first plane and the second plane is less than 15 thousandths of an inch.

24. The web according to claim 21, wherein the distance between the base plane and the second plane is between 3 and 120 thousandths of an inch.

25. The web according to claim 24, wherein the distance between the base plane and the second plane is between 40 and 80 thousandths of an inch.

26. A sheet of tissue exhibiting puffiness and bulk having a plurality of bosses formed therein comprising;

a plurality of stitchlike bosses arrayed to form polygonal cells making up a lattice structure; and

a plurality of bosses forming a first signature emboss pattern being centrally disposed within a plurality of cells, said plurality of bosses having a height exceeding 3 thousandths of an inch and a height less than 120 thousandths of an inch;

a plurality of bosses forming a second signature emboss pattern being centrally disposed within a plurality of cells, said second signature bosses being formed of at least two concentrically arranged arrays of embossments at a height exceeding 3 thousandths of an inch and a height less than 120 thousandths of an inch.

27. The sheet according to claim 26, wherein both signature emboss patterns are crenulated.

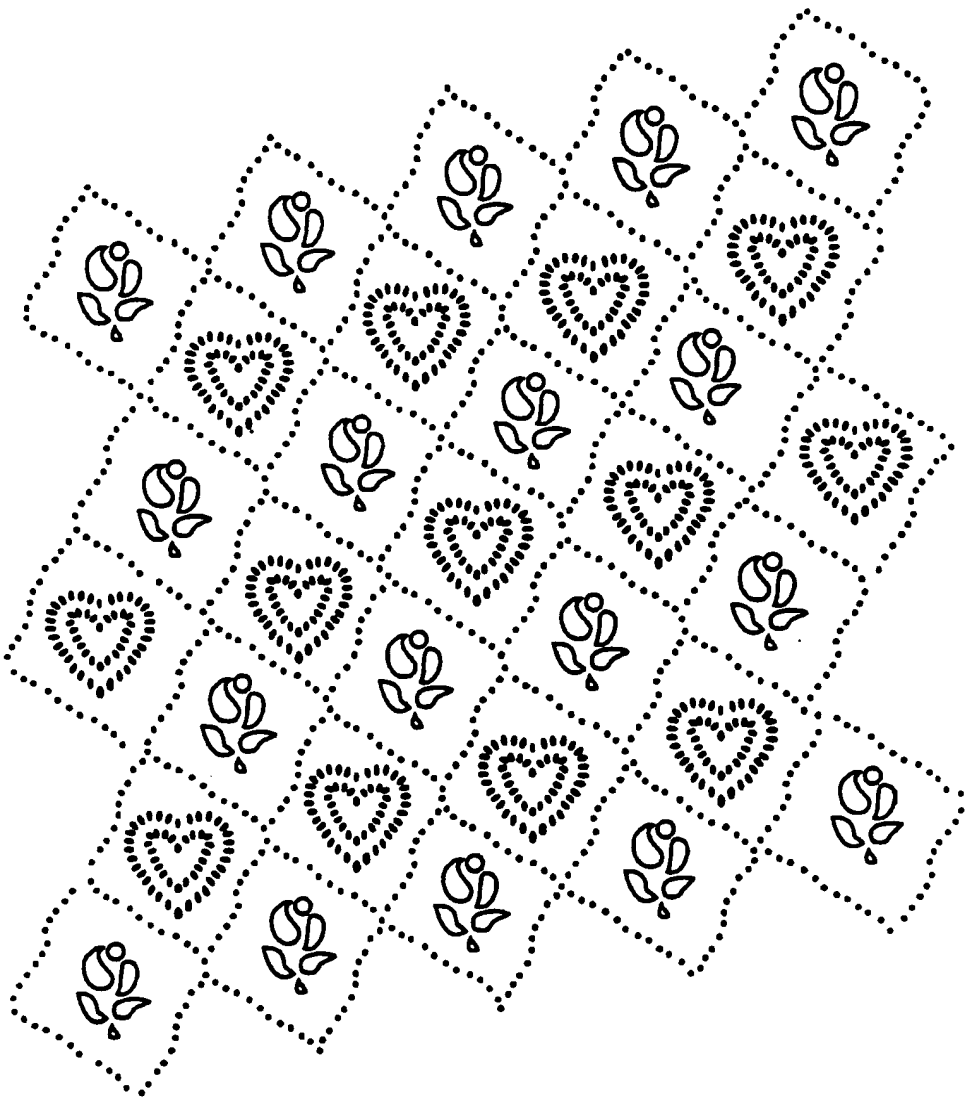


FIG. 1

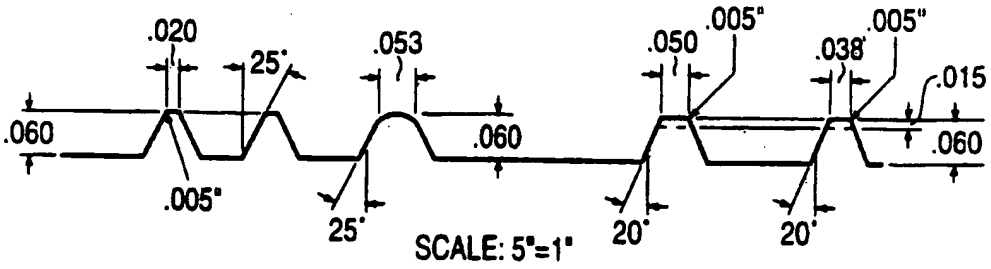


FIG. 2

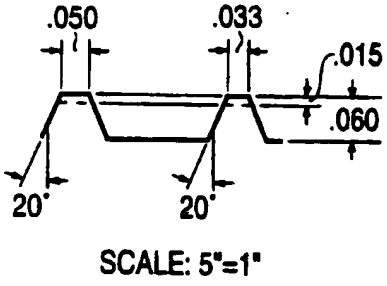


FIG. 4

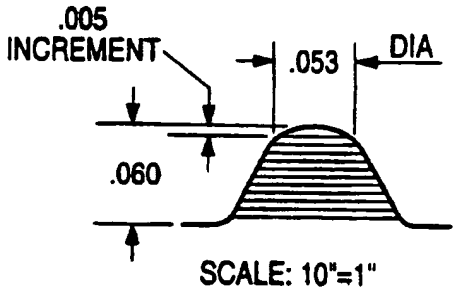


FIG. 5

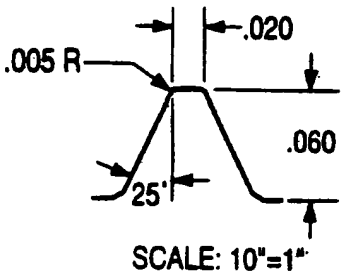


FIG. 8

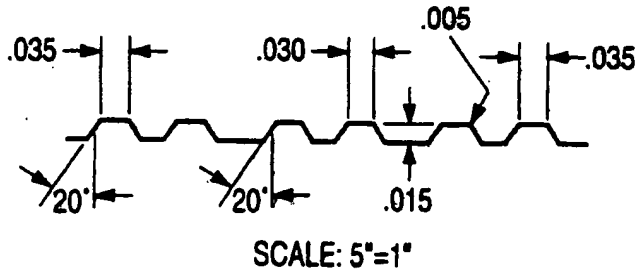


FIG. 12

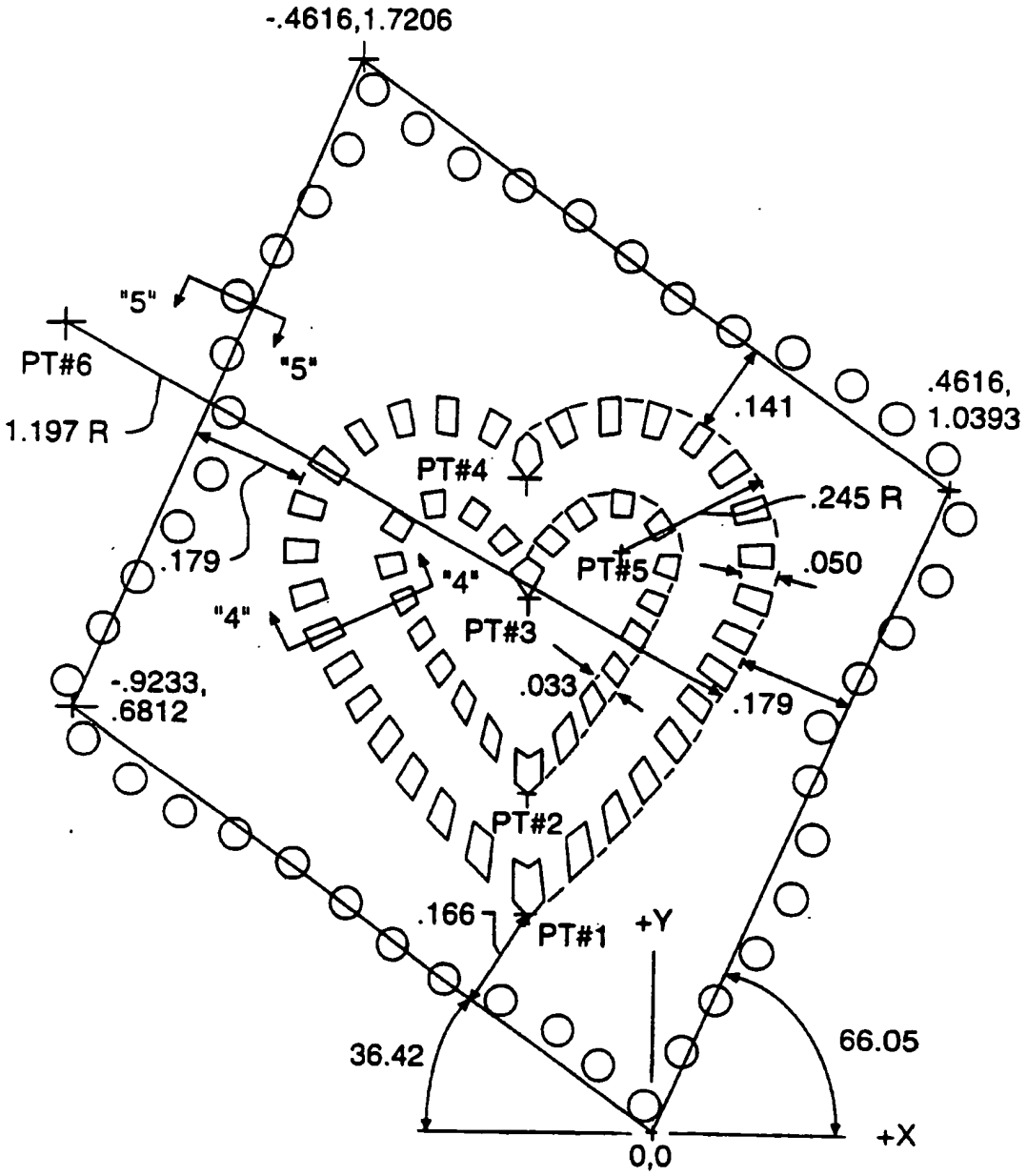

-.4616,1.7206
"5"
"5"
PT#6
1.197 R
.4616,
1.0393
.141
PT#4
.245 R
.179
PT#5
.050
"4"
"4"
PT#3
-.9233,
.6812
.033
.179
PT#2
.166
PT#1
+Y
36.42
66.05
+X
0,0

FIG. 3

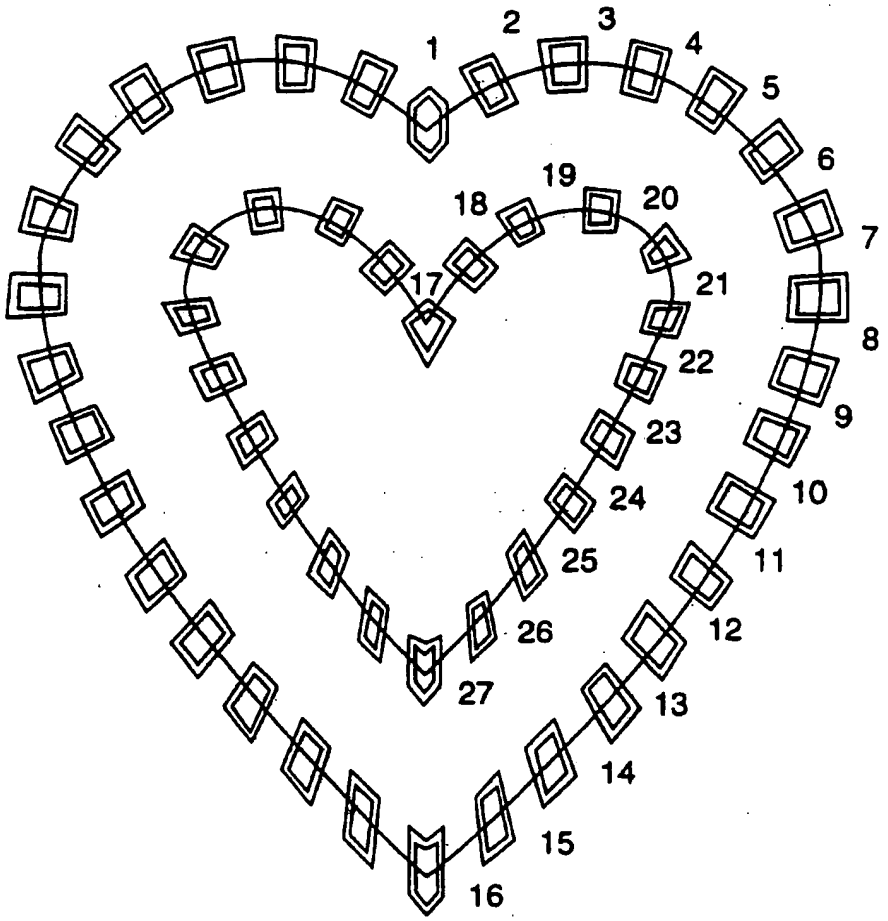


FIG. 6

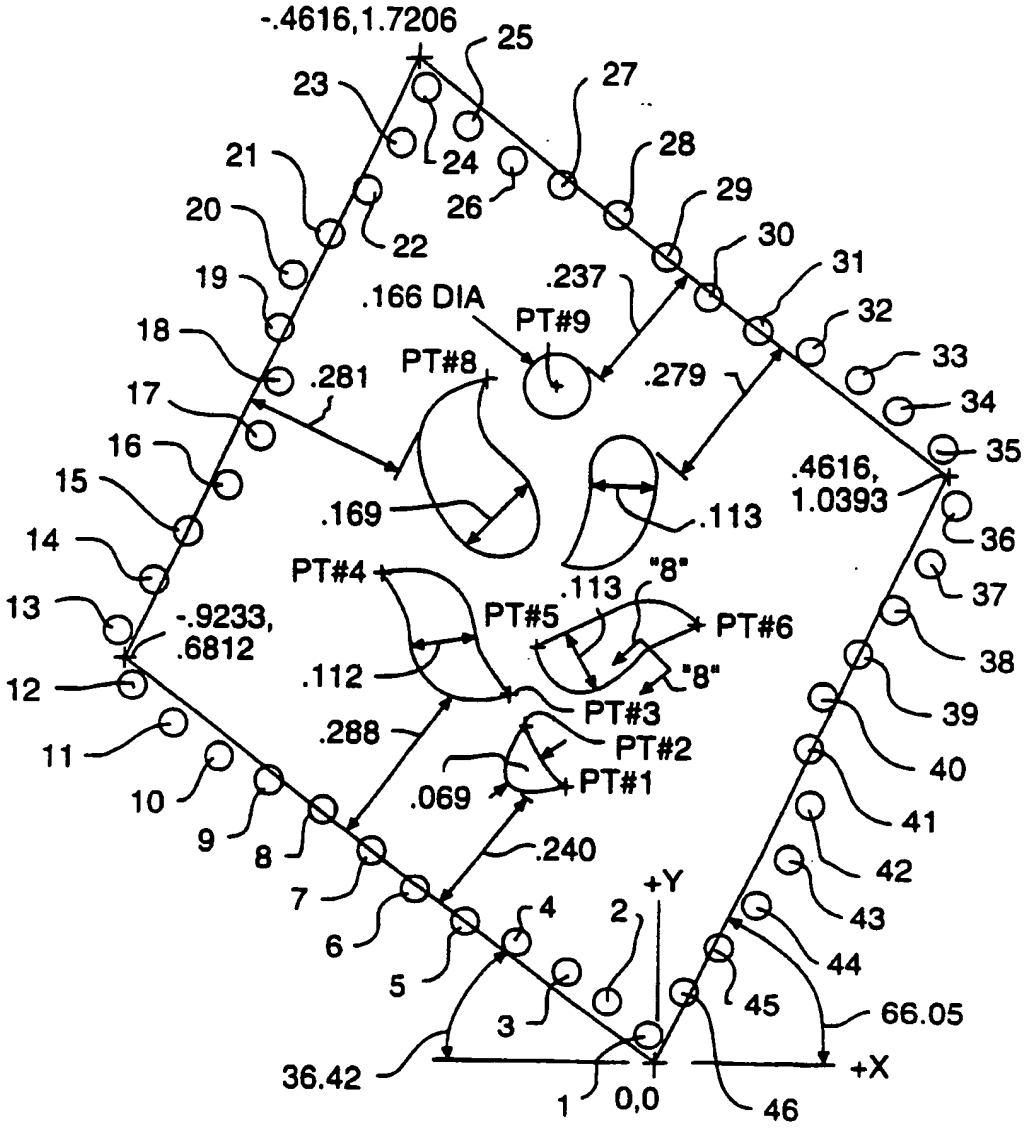

-.4616,1.7206
25
23
27
24
28
21
26
29
20
22
30
19
.166 DIA
.237
31
PT#9
18
PT#8
32
.281
.279
33
17
34
16
35
.4616,
1.0393
15
.169
.113
36
14
PT#4
.113
"8"
37
13
-.9233,
.6812
PT#5
PT#6
38
12
.112
"8"
39
PT#3
.288
PT#2
11
40
PT#1
.069
10
41
9
.240
42
8
+Y
7
4
2
43
6
44
5
45
66.05
3
36.42
+X
1
0,0
46

FIG. 7

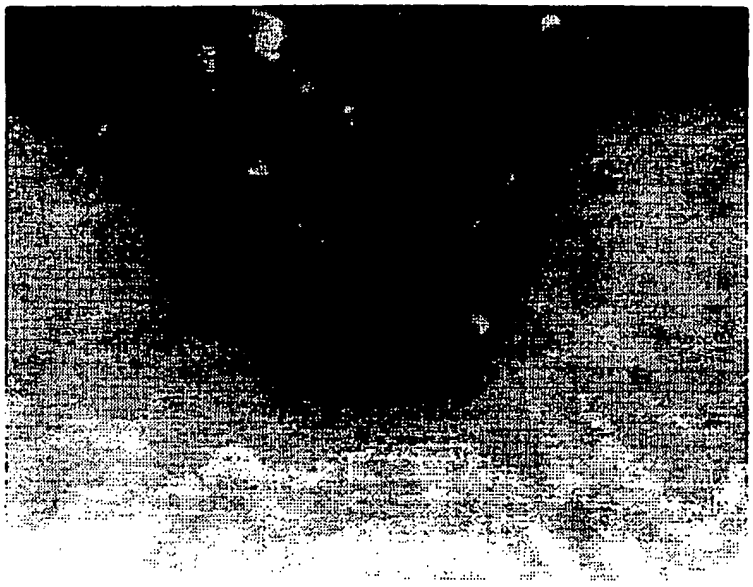


FIG. 9

FIG. 10

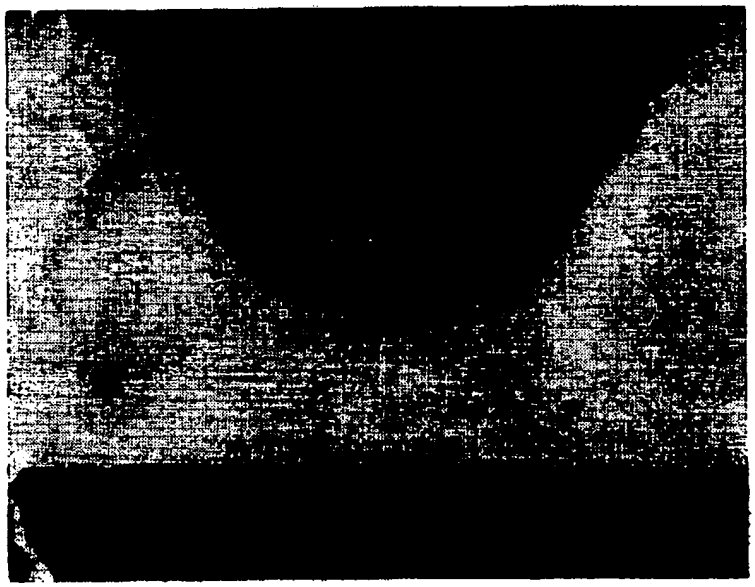


FIG. 11

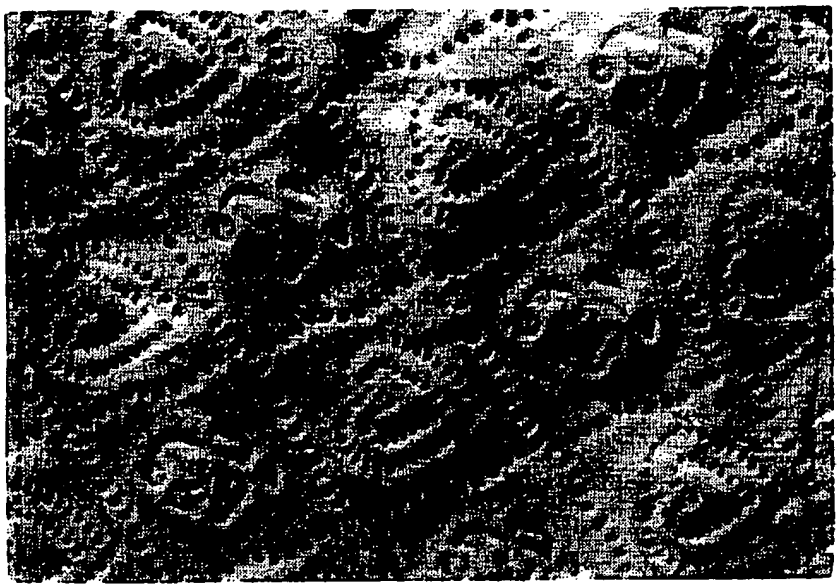


FIG. 14

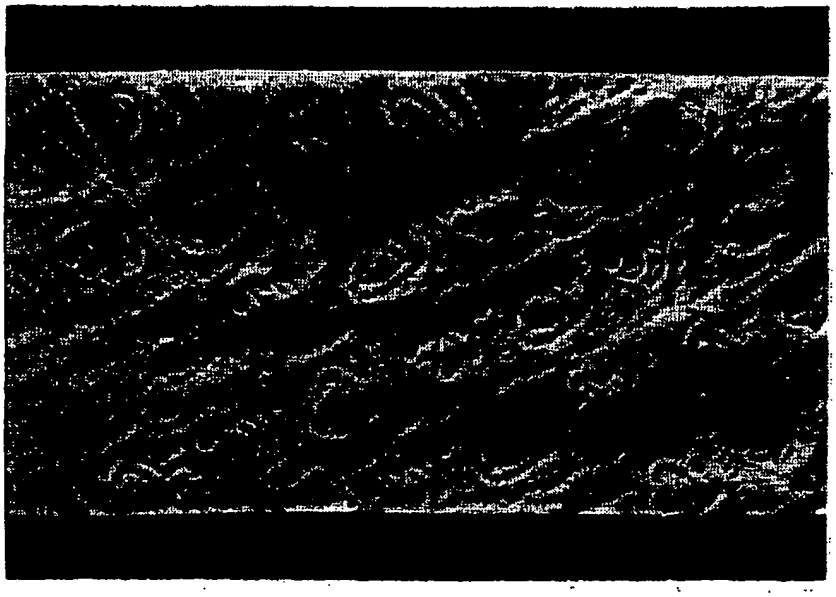


FIG. 13

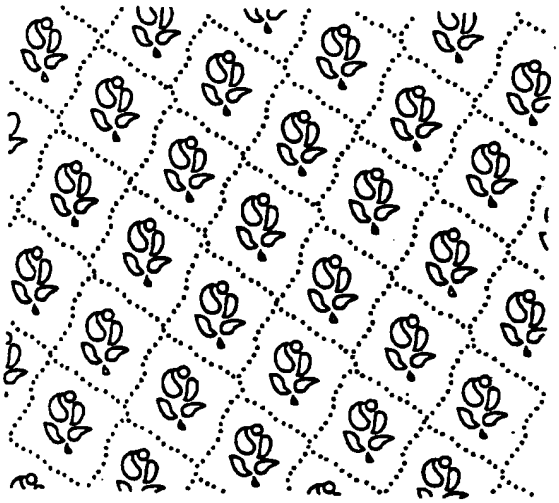


FIG. 15

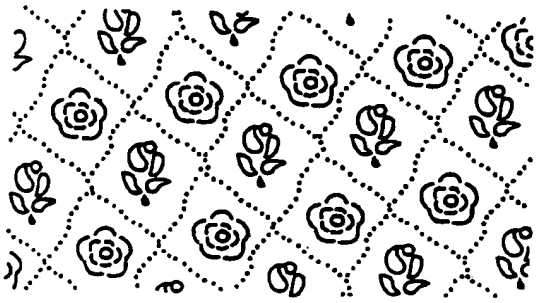


FIG. 16

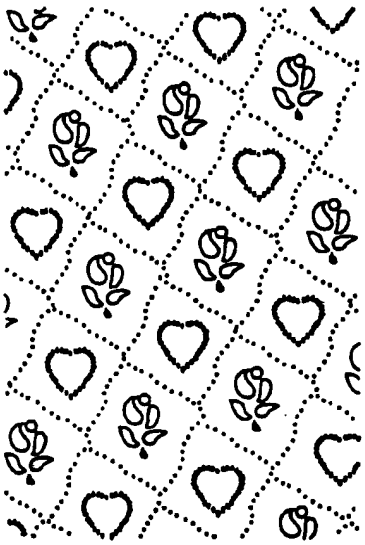


FIG. 17

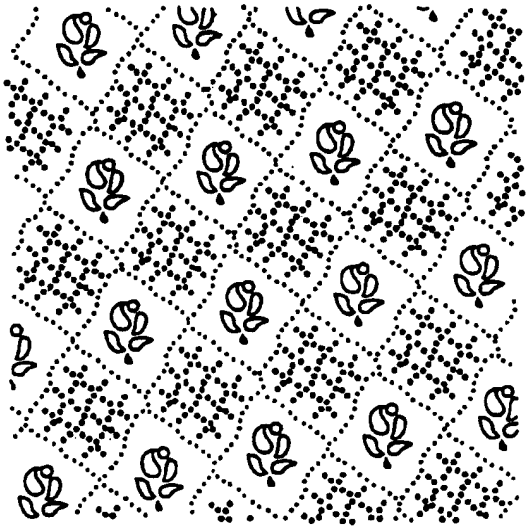


FIG. 18

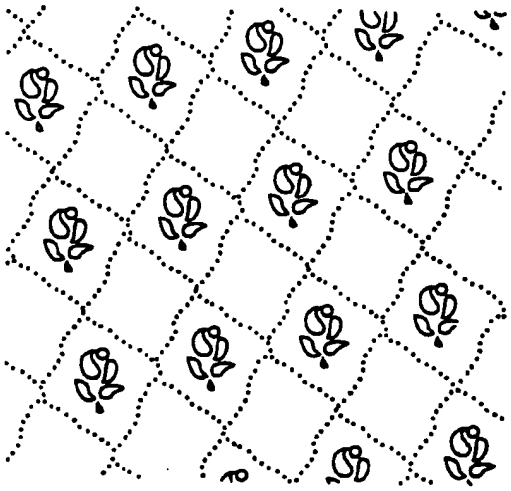


FIG. 19

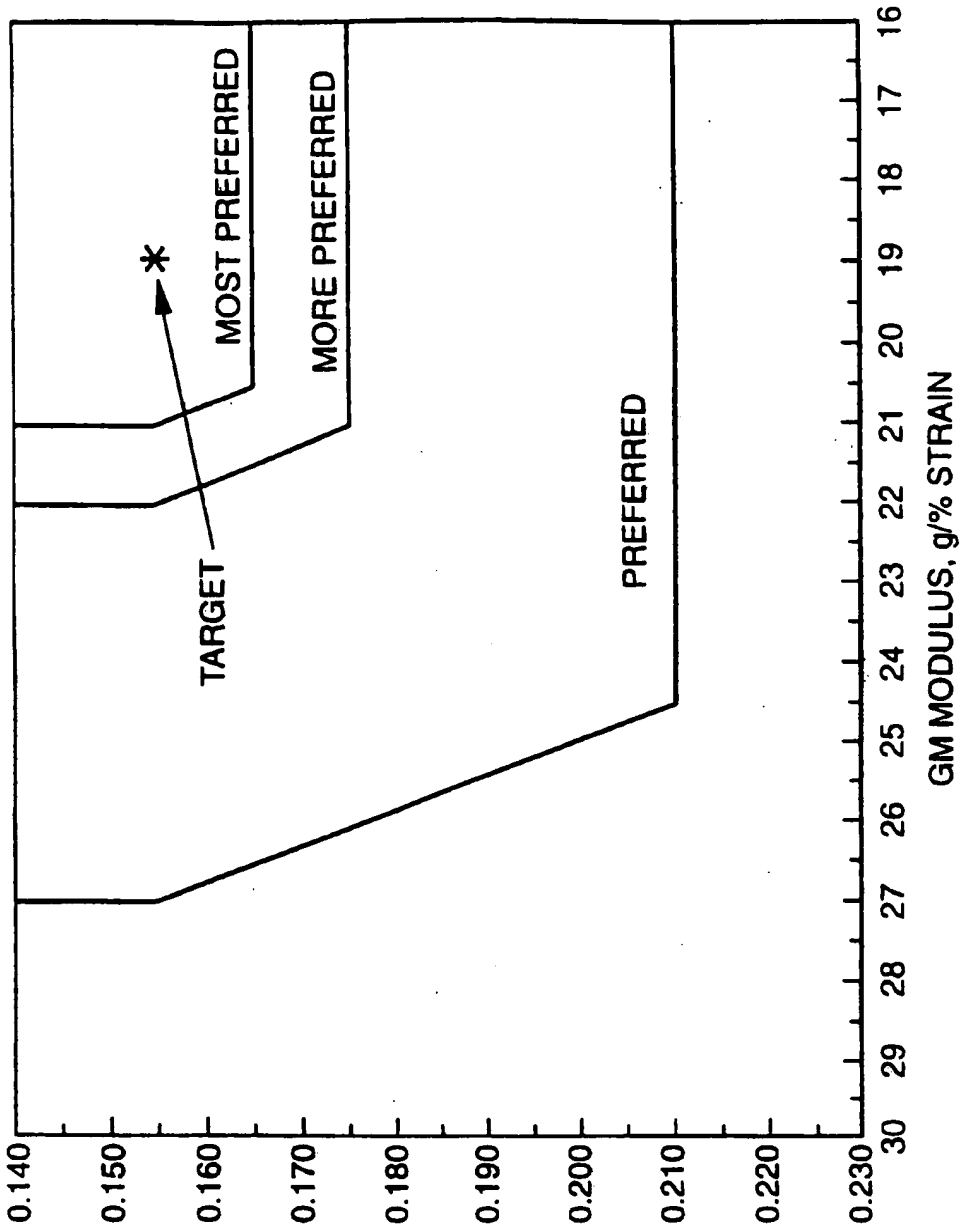

MOST PREFERRED
MORE PREFERRED
PREFERRED
TARGET
*
0.140
0.150
0.160
0.170
0.180
0.190
0.200
0.210
0.220
0.230
GM MMD FRICTION
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
GM MODULUS, g/% STRAIN

FIG. 20

INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/US 96/04777

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 D21H27/02 B31F1/07

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 D21H B31F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of documents, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US,A,4 376 671 (SCHULZ GALYN A) 15 March 1983	1-3
A	see column 3, line 15 - line 23; figures	5-16, 18-27

Y	US,A,4 659 608 (SCHULZ GALYN A) 21 April 1987 see column 3, line 43-48	1-3

A	WO,A,94 23128 (JAMES RIVER CORP) 13 October 1994 see page 2, paragraph 2; claims 1,8; figures see page 5, paragraph 3	1-27

A	FR,A,2 075 453 (CANADIEAN INTERNATIONAL PAPER COMPANY) 8 October 1971 see figures	1-27

	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

1

Date of the actual completion of the international search	Date of mailing of the international search report
18 July 1996	26.07.96

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Kosicki, T

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No: PCT/US 96/04777

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP,A,0 566 775 (KIMBERLY CLARK CO) 27 October 1993 see column 8, line 49 - column 9, line 4	1,18,21, 26
P,A	WO,A,95 35205 (KAYSERSBERG SA ;RUPPEL REMY (FR); LAURENT PIERRE (FR); HUNGLER JOE) 28 December 1995 see figures 2,3	1,18,21, 26
A	US,A,2 890 540 (K. W. BRITT) 16 June 1959 see figures 2-6	1,18,21, 26
P,A	US,A,5 409 572 (KERSHAW THOMAS N ET AL) 25 April 1995 see figures 3,4,6; examples 1,2	1,18,21, 26
A	EP,A,0 565 838 (KIMBERLY CLARK CO) 20 October 1993 see figures	1,18,21, 26

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

information on patent family members

Inter nal Application No
PCT/US 96/04777

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US-A-4376671	15-03-83	US-A-	4320162	16-03-82
US-A-4659608	21-04-87	US-A-	4803032	07-02-89
WO-A-9423128	13-10-94	US-A-	5458950	17-10-95
		CA-A-	2136830	13-10-94
		EP-A-	0642614	15-03-95
FR-A-2075453	08-10-71	CA-A-	967089	06-05-75
		DE-A-	2101190	22-07-71
		GB-A-	1344541	23-01-74
		US-A-	3672949	27-06-72
EP-A-0566775	27-10-93	US-A-	5356364	18-10-94
		AU-B-	646746	03-03-94
		AU-B-	1943792	10-09-92
		AU-B-	5316394	10-03-94
		BR-A-	9300465	19-10-93
		CA-A-	2073496	23-08-92
		JP-A-	6206269	26-07-94
		US-A-	5529563	25-06-96
		US-A-	5503896	02-04-96
WO-A-9535205	28-12-95	FR-A-	2721251	22-12-95
US-A-2890540	16-06-59	NONE		
US-A-5409572	25-04-95	CA-A-	2059410	16-07-92
		EP-A-	0495637	22-07-92
EP-A-0565838	20-10-93	US-A-	5300347	05-04-94
		AU-B-	658975	04-05-95
		AU-B-	3313593	02-09-93
		CA-A-	2089912	27-08-93
		ZA-A-	9300620	30-08-93